EFFECT OF SUBSTRATE AND INDIVIDUAL SIZE ON *MYRMELEON* TRAP SIZE AND CAPTURE EFFICIENCY

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ant lion giggles.
drink of sand. particle of soul;
tire track tornado
flattens tomb of living dead.

Abstract. Ant lion larvae (*Myrmeleon* spp.) build traps in a wide variety of soil types. We hypothesized that the dimensions of a trap would vary across different soil types, and that this difference would affect the foraging efficiency of the resident *Myrmeleon*. We found that larger *Myrmeleon* built traps of larger volume, and that traps constructed in finer soil types have steeper sides. However, we found no significant difference in ant lion capture success between fine and coarse substrates.

INTRODUCTION

Ant lions are important predators of ants and other small arthropods. A better understanding of their distribution may clarify some of the predator-prey interactions of small arthropods in dry tropical forest. *Myrmeleon* spend up to three years as soil-dwelling larvae. They construct conical pits to catch small insects. According to McClure (1983), pit diameter is a good estimate of *Myrmeleon* size. We hypothesized that pit volume would correlate positively with *Myrmeleon* size. We also hypothesized that the relationship between pit volume and *Myrmeleon* size would be affected by the nature of the substrate. Slope angle is a function of substrate, not pit diameter (McClure 1983). Because small-particle soils may pack more densely, we hypothesized that pits constructed in small particle soils would have steeper slopes. We further hypothesized that substrate would affect the capture efficiency of the ant lion, because steeper slopes may influence the effectiveness of the pit.

METHODS

We conducted our experiment over 9-10 January 1995, at two sites east of the Palo Verde Biological Station, Costa Rica. The first site, 30 m from the station, contained coarse, sandy soil. The second, 300 m east of the station on the road to Bagaces, contained fine, carbonate soil.

We grouped the *Myrmeleon* traps into three size classes based on a preliminary visual survey. At each of five random points at our first site, we measured the diameter and depth of the closest small, medium, and large *Myrmeleon* traps. Following trap measurement we captured the *Myrmeleon* and recorded their lengths. At the second site, we used the first five large traps encountered to define our five sampling points and took the same measurements as those taken at the first site.

To measure the capture efficiency of the *Myrmeleon* traps, we placed one *Pseudomyrmex flavicornis* (common red acacia ant) at the base of each trap and recorded the time to capture by the *Myrmeleon* , or time to escape from the trap. All of the *P. flavicornis* ants were collected from the same colony to ensure general uniformity of size and behavior. We used 20 traps between 32 - 40 mm in diameter at each of the two sites. For each trap we measured diameter, depth, capture efficiency, and *Myrmeleon* length.

TABLE 1. Means and standard errors of pit dimensions and ant lion lengths

Substrate	Pit Volume (mm^3)	Pit Depth (mm)	Pit Diameter (mm)	Ant Lion Length (mm)
Coarse	216.7 ± 46.3	13.3 ± 1.2	26.6 ± 2.1	8.9 ± 0.8
Fine	245.3 ± 38.9	18.5 ± 1.4	28.7 ± 2.8	10.6 ± 0.8

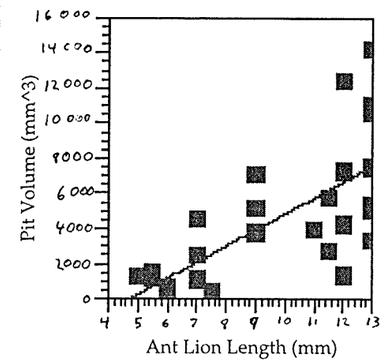

FIG. 1. Pit volume as a function of ant lion length (combined values of coarse and fine substrates; n=29).

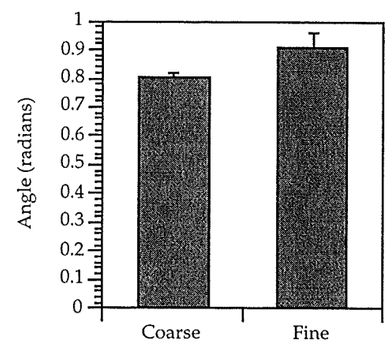

FIG. 2. Mean ± 1 SE of angles of pits built by ant lions in coarse and fine soil (coarse n=14, fine n=15; p=0.037).

RESULTS

Myrmeleon length positively correlated with pit volume (2-way ANOVA,P<0.001, Fig 1). However, this relationship did not differ significantly between the two substrates (F=0.286 P=0.598). (The data on pit dimensions and Myrmeleon length are included in Table 1 for future reference). *Myrmeleon* in the fine soils built their pits at steeper angles than *Myrmeleon* in the coarse soils (t-test, P=0.037). The mean pit angle was 45.9° in the coarse soil, and 52.2° in the fine soil (Fig. 2). There was no significant relationship between capture time and substrate type (Mann-Whitney U-test, P=0.416).

DISCUSSION

We expected small ant lions to build disproportionately small traps in coarse soil due to the weight of the soil particles. However, we found no difference in the relationship between pit volume and *Myrmeleon* size for different substrates. We did find that pits constructed in finer soils had steeper sides. The angle of repose, the maximum angle which the wall of the pit can sustain without subsiding, is apparently higher in the finer particulate substrate we sampled, probably because the particles pack more closely together. Although not statistically significant, the mean capture time in the coarse soil (33.2 s) was greater than the mean capture time in the fine soil (24.1 s). Moreover, three ants escaped from traps in the course soil, while none escaped from traps in the fine soil.

The ant's ability to escape the pit seems to depend partially on its ability to decrease the angle of the pit wall. When the ant tries to climb out of the trap, the wall of sand avalanches, decreasing the depth of the pit and thus the angle of the pit wall. At the same time, however, the ant lion flicks sand out of the pit and reconstructs the steeper slope. Our observations suggest that the finer substrate cascades more readily on top of the ant than does the coarse substrate. The ants tire with each successive cascade of soil and are ultimately consumed.

Ant lions also build pits in the very dry and hard packed black "cotton" soil which is characteristic of the Palo Verde area. It

would be interesting to study the effects of this and other substrates on ant lion capture efficiency. Ant lion larvae exhibit exploratory behavior prior to pit construction (McClure 1983). In a pilot study we conducted, ant lions in "foreign" soils took much longer to build traps than those placed in the soil type from which they were taken. Future study might address ant lion preference for different substrates.

LITERATURE CITED

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